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The Teaching of Procedural Skills During Surgery Rotation: Are Students Learning Enough?

A Thesis Submitted to the

Yale University School of Medicine

in Partial Fulfillment of the Requirements for the

Degree of Doctor of Medicine

By

Samantha Louise Wood

2006

Abstract

THE TEACHING OF PROCEDURAL SKILLS DURING SURGERY ROTATION: ARE STUDENTS LEARNING ENOUGH? Samantha L. Wood (Sponsored by Sanziana Roman). Department of Surgery, Yale University, School of Medicine, New Haven, CT.

This study has several aims:

1. assess student exposure to procedural skills training during the core surgery rotation,

2. determine whether procedural goals set by the Yale Department of Surgery are being met, 3. investigate potential discrepancies in education in procedures based on the gender of the student, and 4. evaluate who is providing the majority of procedural training to students (i.e. residents or faculty, women or men, etc).

An original survey was distributed to third-year medical students at the completion of their core surgery clerkship. It assessed their experiences with a list of 22 procedures and collected demographic data. These data were analyzed based on student gender, core surgical rotation site, and instructor level.

On average, students met expectations of exposure to 6 out of 13 procedures considered "important for students to learn" by the Department of Surgery, but did not have the expected level of exposure to the remaining 7 listed procedures. There were few overall gender differences among student regarding the level of experience with procedures; however, at the Veteran's Administration Medical Center, men reported significantly more experience in 4 of the 22 procedures. The vast majority of instruction in procedural skills was performed by surgical housestaff, with both female housestaff and female

attendings teaching a greater proportion of procedures than their representation in the residency/faculty body would predict.

Medical students at Yale are not gaining experience with surgical procedures to the extent that the department believes they should. In general, there is equal experience with procedures between genders. A formalized checklist of procedures may be helpful in assuring that students have adequate exposure to the surgical procedures they are expected to encounter.

Acknowledgements

Many thanks to Dr. Sanziana Roman for her assistance and guidance with this project, and to Dr. Richard Gusberg and the Yale University School of Medicine Department of Surgery for their support. Thanks also to Dr. Valentine Njike for his statistical expertise and to Lee Sylvestre for his help with data collection.

Table of Contents

Introduction

Exposure to procedural skills is an important aspect of medical education. A 1989 survey of practicing physicians showed that on average physicians performed 16 procedural skills in their practice, with 14 procedures regularly being performed. Physicians practicing in smaller communities (less than 25,000 people) and in smaller hospitals (less than 100 beds) performed more procedures than those in urban areas or larger hospitals (1). In order to effectively prepare doctors-in-training for this aspect of practice, it must be clarified what procedures students and housestaff must learn, how best to teach them, who is responsible for teaching them, and how to assess competency (2, 3). Doctors in many specialties are responsible for performing procedures: a survey of medicine residents and faculty identified 30 procedures that 80% of responders agreed should be mastered by graduating medical residents (4). A student's greatest exposure to procedural skills is often expected to occur during their surgical clerkship.

Which procedural skills should be taught on a student surgical clerkship? Surveys have asked residents, surgical educators, and practicing physicians to rank the importance of a list of clinical skills (5) and found general agreement on which specific skills (both procedural and general) students should be expected to learn on a surgical rotation (6) (table #1). At the beginning of a third-year student's core surgery rotation, the Yale Department of Surgery distributes a booklet of clerkship guidelines, which includes expectations for exposure to surgical procedures (7) (table #2).

Table 1

Surgical skills which students should have performed or be proficient in according to surgeons and surgical residents (Lawrence 1983)	**Clinical skills medical students should learn on surgical rotations—**ranked in the top 20 by surgical faculty as well as primary care physicians and faculty. (Curet 1999)
History and physical exam	Abdominal examination
Sterile technique	History and physical
Venipuncture	Daily progress notes
Gown and Glove	Admission orders
Daily surgical note	Sterile technique
Admission orders	Assessing wound healing
Inserting intravenous catheter	Suture/staple removal
Suture removal	Aseptic dressing change
Drawing arterial blood	Drawing venous blood
Postoperative note and orders	Preoperative evaluation/orders
Preoperative evaluation and orders	Injection administration
Inserting nasogastric tube	Gowning and gloving
Aseptic dressing changes	Patient presentation on rounds
Assessing wound healing	Skin staple/suture
Skin suture	Inserting intravenous catheter
Inserting urethral catheter	
Closed chest massage	
Skin closure	
Knot tying (hand)	
Administering injections	
Wound dressings	
Mouth-to-mouth resuscitation	
Instrument knot tying	
Ventilation by Ambu Bag	

Table 2

Surgical Procedure guidelines for 3rd year core surgery rotation: Yale Department of Surgery
Discuss the purpose of a nasogastric tube and list the risks, indications, and contraindications for insertion and removal
Given an actual patient, demonstrate the ability to intubate the stomach with a nasogastric tube, including proper positioning and care
List the indications, contraindications, and possible complications of passage of a urethral catheter, and demonstrate the ability to insert it.
Describe the indications for drain placement, advancement, and removal, as well as possible complications associated with their use
List the indications, contraindications, and complications associated with the insertion of central venous catheters, Swan-Ganz catheters and arterial catheters and participate in their placement
Demonstrate the ability to insert intravenous catheters for the delivery of intravenous fluids or medications
Perform venipuncture for blood sampling
Identify, describe, and manage complications secondary to venipuncture or arterial puncture
Appropriately care for open wounds, including dressing changes, minor debridements; demonstrate ability to recognize infected, poorly-healing and healthy granulating wounds
List the indications, contraindications, and complications associated with the placement of chest tubes
Demonstrate the use of a continuous wave Doppler in assessing peripheral pulses and determining the use of the ankle-brachial index.
Demonstrate facility with basic suturing techniques and knot tying.

The common refrain “see one, do one, teach one” implies that the opportunities to learn procedural skills are plentiful and that enthusiastic teachers are in abundance. However, it has been shown that medical student exposure and mastery of procedures is less than expected by educators and physicians (8,9,10). Many medical schools offer solely an introduction to phlebotomy, with no other official procedural instruction (11). Medicine clerkships may be insufficient in exposing students to procedural skills, with only 60-80% of students reporting exposure to mandatory procedures (12,13). Testing of certain clinical skills using standardized patients supports this insufficiency (14). The

inadequacy of procedural skills training is not limited to undergraduate medical education; medicine residency program directors agree that residents fall short in terms of procedural skills training (15).

An important priority in addressing the overall inadequacy of procedural skills training in medicine is to improve teaching. Hamdorf's review of surgical skills training underscores the importance of a theoretical basis for the teaching of surgical skills and the importance of apprenticeship-based teaching (16). A 7-point model for the teaching of clinical skills has been suggested as an alternative to "see one, do one, teach one," and was well received by physician educators (17). Additionally, the availability of a checklist of procedures to which students could expect exposure on a rotation may increase experience, even without additional specific requirements (18). Finding ways to improve teaching of clinical skills in medicine may be particularly important in the new era of reduced resident work hours, as student perceptions of surgical residents showed an increase in negative comments about resident teaching after duty hours regulations took effect (19).

Gender and procedural skills

It is clear that gender has an effect on both student experience in medical school and career choice. Women report less satisfaction with their medical school curriculum and greater gender discrimination during medical school than men (20). In response to surveys specifically addressing surgery rotation, women report more negative

experiences, fewer mentors, and were less likely to agree that men and women were treated comparably in surgical training (20,21).

There has been speculation that the increase in the percentage of women in the medical field is related to the decrease in students choosing careers in general surgery (from 7.8% in 1987 to 5.8% in 2002) (22). One study showed that women did not differ from men in the given reasons for not choosing a surgical field (23), although another study reported a relative lack of a same-sex role model, beliefs that sexual discrimination occurs in general surgery, and the possibility of parental leave as reasons for women not choosing surgery as a specialty (24). It is clear that women mentors are an important resource for female medical students considering a career in surgery. Women who attend medical schools with a greater proportion of female surgeons are more likely to choose a career in surgery, even though their reported perceptions of surgeons do not differ from those of students at schools with fewer female surgeons (25).

Women are more likely than men to cite a positive clerkship experience as a reason to choose a career in surgery (21). This, combined with female students' perception that gender discrimination is a problem in the surgical field and the impact that female role models have on their career choice, emphasizes the importance of creating a positive clerkship experience free of gender discrimination, with exposure to female role models for women medical students.

Approaching these issues from the perspective of surgical procedures training helps to narrow the focus. Anecdotal evidence from medical student experiences often shows that female medical students perform fewer procedures on their surgery rotation than men. This may be a result of being given fewer opportunities or of being less aggressive

in pursuing these opportunities. There is a paucity of literature on this topic. One study focused on a family medicine rotation showed that women had more exposure to "female specific" skills (i.e. breast and pelvic exams) while men had more exposure to "male specific" skills (i.e. testicular exam) (26). However, this may not apply to procedures commonly encountered on a surgery rotation, which are more likely to be gender neutral (blood draws, suturing, etc.). Female medical students consistently underestimate their performance on surgery rotations and their competency in procedural skills relative to faculty evaluations (27).

In summary, it is clear that physicians in training as a whole have insufficient exposure to procedural skills. It is unclear whether there is a gender discrepancy in procedural skills exposure in medicine; however, female medical students certainly perceive that gender discrimination is common in the surgical profession. This may detract from the positive clerkship experiences they value in choosing a surgical career. The aim of this study was to assess the relative exposure to procedural skills training for male and female medical students at Yale University School of Medicine during their surgical clerkship, clarify areas that require improvement, and identify the gender and role of those teaching procedures to students.

Hypothesis

Male medical students report greater exposure and experience with procedural skills (as outlined in the surgery department's "learning objectives" as well as other commonly

encountered procedures) than female medical students during the core portion of the third-year surgery rotation.

Additional Aims of Thesis

The purpose of this research is to assess several aspects of medical student education in procedural skills:

1. How much exposure to procedures do third-year medical students have in the required portions of the surgery rotation?
2. Is there a difference in students' exposure to clinical skills based on their gender, age, or assigned rotation site?
3. Who are the most common teachers of surgical procedures (gender, hierarchical academic status and position)?

Methods

An anonymous survey was distributed to third-year students during the final class meeting of their surgery rotation. The original survey, specifically designed for this study, listed 22 procedural skills, which were selected based on the "Learning Objectives—General Surgery Clerkship Skills and Knowledge: Surgical Procedures" packet as well as discussions with surgeons involved in the teaching of medical students. For each of the 22 procedures students indicated their level of experience with the procedure on a 5-point scale: 0=never seen or done, 1=have observed or was taught

about, 3=performed with assistance, 4=performed independently with supervision, and 5=performed independently without supervision. For each procedure students also self-rated their level of competence from 0=never done to 3=very competent as well as indicated the training level and gender of the person they identified as their teacher.

Data on student gender, age, prior surgical experience, assigned site for the core surgery rotation, and interest in various medical specialties was also collected. The surveys were obtained at the final meeting of students at the end of the core surgery rotation. Students were instructed to consider only the month-long surgery rotation in their answers to the procedural experience category (for example, if a student had sutured on a prior rotation but had not during the core surgery rotation, they would check "never seen or done"). All data was kept confidential and students were informed that the data they provided would not be seen by anyone responsible for evaluating them.

This project was granted an exemption from review by the HIC.

Results

Yale students complete this rotation on one of three teams: Gastrointestinal surgery at Yale-New Haven Hospital, Surgical Oncology at Yale-New Haven Hospital, or General Surgery at the Veteran's Administration Medical Center in West Haven, Connecticut. During the month-long rotation students participate in pre-and post-operative care, observe and participate in the OR, attend surgical clinic, and take call with their team.

117 students rotated through the core surgery rotation from July 2004 to August 2005. 80 responded to the survey for a response rate of 68.4%.

Table 3

Demographic Data

Gender	**Number**	**Percentage**
Male	39	48.8%
Female	40	50%
No answer	1	1.3%

Age	Range	Median	Mean	SD
Age	22-37	25	26.18	3.06

Site	**Number**	**Percentage**
Oncology (Red Team)	28	35%
GI (Blue Team)	23	28.8%
VA Hospital	23	28.8%
Other/no response	6	7.5%

Prior Surgical Experience	**Number**	**Percentage**
Yes	45	56.25%
No	33	41.25%
No Answer	2	2.50%

Type of Prior Surgical Experience	**Number**	**Percentage**
Completed Surgery B before starting surgery A	30	37.50%
Completed a surgical elective prior to starting surgery A	11	13.75%
Have family/friends who exposed me to surgical procedures	7	8.75%
Worked in a medically related field prior to coming to medical school	5	6.25%
Gained surgical experience in a way not listed above	20	25.00%

Career Interests	0=not interested 1=slightly interested 2=moderately interested 3=very interested 4=extremely interested					
	0	**1**	**2**	**3**	**4**	**Ave**
Medicine	10	9	29	23	7	2.103
Surgery	11	8	15	27	16	2.391
Pediatrics	22	18	21	12	5	1.487
Psychiatry	42	25	8	1	2	.667
OB/GYN	42	17	12	2	4	.818

Students' reported experience with the list of procedures is shown below (table 4, figure 1). Experience varied with procedure: for example, 65 out of 80 students (81.25%) reported that they had independently done wound care (either with or without supervision), while 74 out of 80 (92.5%) had never been taught about or observed an abdominal tap.

Students' reports of their experience with procedures often fell short of the objectives listed in the "Learning Objectives" information distributed to students at the beginning of the general surgery clerkship. For several skills that all students are expected to perform less than 2/3 of the students reported performing the procedure: 52/80 (65%) performed venipuncture, 46/80 (58%) inserted an IV, 35/80 (44%) placed an NG tube, and 33/80 (41%) performed a Doppler pulse exam. Regarding procedures that the majority of students performed during the rotation, a small number of students had never performed the basic skill: 12/80 (15%) never inserted a Foley catheter in a male patient, 7/80 (9%) never tied a knot or performed wound care, and 5/80 (6%) never sutured. Many students had no exposure to procedures which they were expected to observe: 31/80 (39%) never observed a central venous catheter placement, 47/80 (39%)

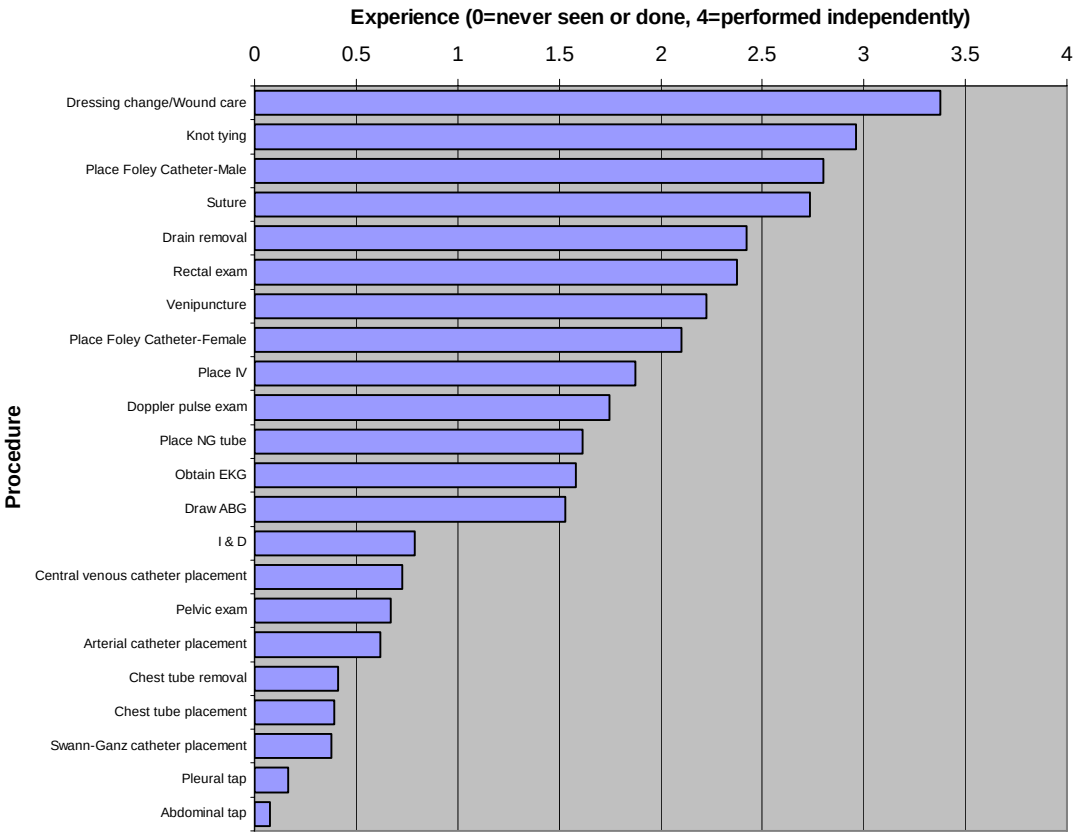
never observed an arterial catheter placement, 51/80 (64%) never observed a Swann-Ganz catheter placement, and 66/80 (83%) never observed a pleural tap.

Table 4

Student Procedural Experience

Procedure Procedures listed in **Bold** are to be performed by students per the curriculum objectives. Procedures in *italics* are to be observed.	Experience 0=never seen or done 1=observed or taught about 2=performed with assistance 3=performed independently with supervision 4=performed independently without supervision					
	0	**1**	**2**	**3**	**4**	**Average**
Dressing change/Wound care	0	7	8	13	52	3.375
Knot tying	1	6	8	43	20	2.962
Place Foley Catheter-Male	3	9	2	54	13	2.8
Suture	3	2	13	57	5	2.734
Drain removal	6	20	6	27	19	2.423
Rectal exam	18	9	8	10	32	2.377
Venipuncture	18	11	10	17	24	2.225
Place Foley Catheter-Female	18	8	7	40	6	2.101
Place IV	21	12	12	24	10	1.873
Doppler pulse exam	37	9	0	3	30	1.747
Place NG tube	18	27	6	26	3	1.613
Obtain EKG	26	16	11	5	18	1.582
Draw ABG	23	19	16	14	7	1.532
I & D	36	26	8	6	0	0.789
Central venous catheter placement	31	38	6	2	0	0.727
Pelvic exam	60	5	2	4	8	0.671
Arterial catheter placement	47	21	5	6	0	0.620
Chest tube removal	55	17	3	3	0	0.410
Chest tube placement	51	24	0	2	0	0.39
Swann-Ganz catheter placement	51	24	1	1	0	0.377
Pleural tap	66	13	0	0	0	0.165
Abdominal tap	74	4	1	0	1	0.076

figure 1: Student Experience by Procedure



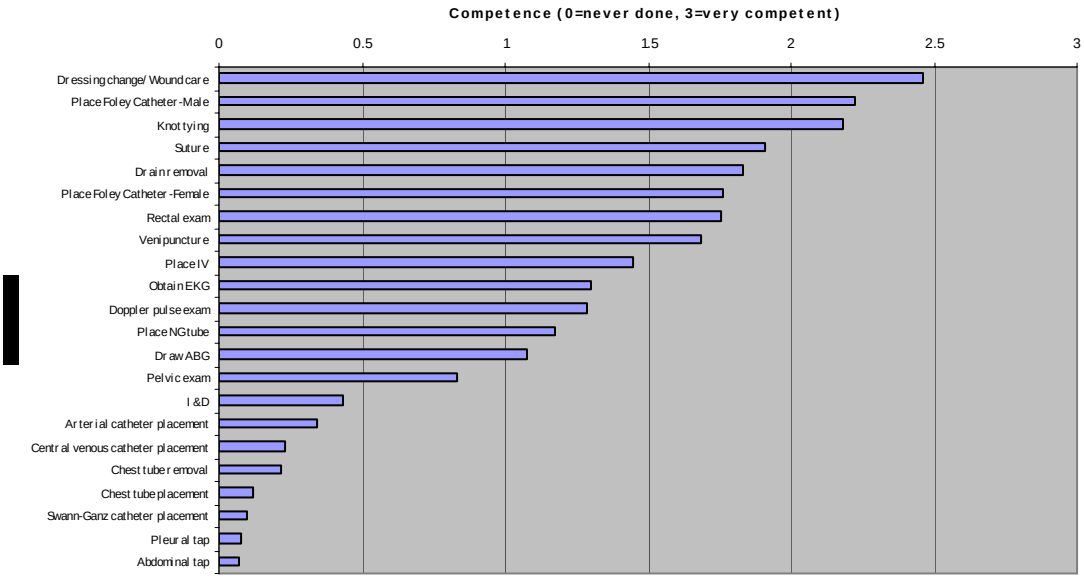
Students' self-reported competence with various procedural skills is shown below (table 5, figure 2). In general, students reported greater competence with procedures they had more exposure to: 73/80 (91%) reported they were "somewhat" or "very" competent at knot tying, 72/80 (90%) reported this level of competence with would care, and 68/80 (85%) reported this level of competence with male Foley placement. Understandably, students reported their own competence with advanced procedures such as pleural tap and abdominal tap very low.

Table 5

Student Self-rated Competence

Procedure	Self-rated competence 0=never done 1=not competent 2=somewhat competent 3=very competent				
	0	1	2	3	Average
Dressing change/Wound care	1	7	26	46	2.463
Place Foley Catheter-Male	11	1	27	41	2.225
Knot tying	2	3	52	21	2.179
Suture	4	12	39	14	1.910
Drain removal	16	6	29	25	1.829
Place Foley Catheter-Female	21	2	31	25	1.759
Rectal exam	23	3	21	30	1.753
Venipuncture	16	11	34	18	1.684
Place IV	20	13	38	9	1.45
Obtain EKG	30	13	15	19	1.299
Doppler pulse exam	41	0	4	29	1.284
Place NG tube	32	8	32	7	1.177
Draw ABG	33	13	25	7	1.077
Pelvic exam	48	4	17	9	0.833
I & D	56	8	11	1	0.434
Arterial catheter placement	59	9	7	1	0.342
Central venous catheter placement	63	10	4	0	0.234
Chest tube removal	64	3	5	1	0.219
Chest tube placement	69	2	2	1	0.122
Swann-Ganz catheter placement	67	7	0	0	0.095
Pleural tap	74	4	1	0	0.079
Abdominal tap	71	3	1	0	0.067

figure 2: Student self-reported competence by procedure



Gender and Procedural Skill Experience

Students' report of procedural skill experience by gender at all rotation sites is shown below. Male students performed significantly more female foley insertions and chest tube removals. No other gender differences were significant. (table 6)

Table 6

Procedural Experience by Gender-- All Sites

Procedure	Mean Experience level-Female	Mean Experience level- Male	P-value
Place NG Tube	1.5	1.7436	.3952
Place Foley-Male	2.8974	1.3684	.3736
Place Foley-Female	**1.7179**	**2.4615**	**.0147**
Place IV	1.875	1.9211	.8872
Venipuncture	2.25	2.1538	.7856
Dressing change/Wound care	3.4	3.3333	.7668
Draw ABG	1.5	1.5526	.8623
Pleural Tap	0.225	0.1026	.1460
Abdominal Tap	0.075	0.0769	.9783
Chest Tube Placement	0.295	0.4872	.1694

Chest Tube removal	**0.15**	**0.6842**	**.0018**
Drain Removal	2.6154	2.2308	.1983
Doppler Pulse exam	1.8	1.6923	.8006
Suture	2.65	2.8205	.3344
Knot tying	2.925	3	.7122
Central Venous Catheter Placement	0.775	0.6757	.5482
Swann-Ganz Catheter Placement	0.3846	0.3684	.9044
Arterial Catheter Placement	0.625	0.6154	.9629
I & D	0.7895	0.7895	1.000
Obtain EKG	1.6	1.5641	.9205
Pelvic Exam	0.875	0.4615	.1740
Rectal Exam	2.5385	2.2105	.3881

Since students are rotating at three different sites during the surgery rotation, it is possible that their experiences differ between sites. Dividing the data according to the site at which students rotated does yield different results from grouping them together. The greatest difference is seen among students rotating at the VAMC: male students at this site reported significantly greater experience in chest tube placement, chest tube removal, Doppler pulse exam, and obtaining EKG's than female students did. At the remaining two sites there was greater equality between the genders. Men who rotated on the Surgical Oncology team reported significantly more experience with chest tube removal than women. No significant differences were observed between genders on the Gastrointestinal (GI) Surgery team. (tables 7,8,9)

Table 7

Procedural Experience by Gender: VAMC

Procedure	Mean Experience level-Female (n=14)	Mean Experience level- Male (n=9)	P-value
Place NG Tube	1.4286	2.1111	.1683
Place Foley-Male	2.7857	3.1111	.5110
Place Foley-Female	0.6923	1.7778	.1007
Place IV	1.7143	2	.6520

Venipuncture	2.6429	3.3333	.2726
Dressing change/Wound care	3.5	3.7778	.4786
Draw ABG	1.1429	2.375	.0682
Pleural Tap	0.2143	0.2222	.9661
Abdominal Tap	0	0.2222	.3466
Chest Tube Placement	**0.3077**	**0.7778**	**.0303**
Chest Tube removal	**0.1429**	**0.8889**	**.0452**
Drain Removal	2.1429	2	.8054
Doppler Pulse exam	**2.8571**	**4**	**.0294**
Suture	2.6429	3	.0961
Knot tying	2.6429	3.3333	.0856
Central Venous Catheter Placement	0.5147	0.6667	.6645
Swann-Ganz Catheter Placement	0.3571	0.5612	.5148
Arterial Catheter Placement	0.7857	0.1111	.0622
I & D	0.8462	1.1111	.5537
Obtain EKG	**2.0714**	**3.8889**	**.0021**
Pelvic Exam	0.8571	1.3333	.5473
Rectal Exam	3.1429	3.3333	.7116

Table 8

Procedural Experience by Gender: Surgical Oncology Team

Procedure	Mean Experience level-Female (n=14)	Mean Experience level- Male (n=14)	P-value
Place NG Tube	1.5	1.7143	.6928
Place Foley-Male	2.5	2.7857	.4172
Place Foley-Female	2.4286	2.4286	1.0000
Place IV	1.9287	1.7143	.7115
Venipuncture	1.7857	1.7857	1.0000
Dressing change/Wound care	3.5	3.2143	.4717
Draw ABG	1.8571	1.2143	.1377
Pleural Tap	0.1429	0	.1648
Abdominal Tap	0.0714	0	.3356
Chest Tube Placement	0.1429	0.2143	.6369
Chest Tube	**0.2143**	**0.8571**	**.0328**

removal			
Drain Removal	2.6923	2.2857	.2885
Doppler Pulse exam	1.2857	0.6429	.2198
Suture	2.4286	2.8571	.5058
Knot tying	3	2.7857	.4064
Central Venous Catheter Placement	1	0.7143	.8898
Swann-Ganz Catheter Placement	0.4615	0.5	.8050
Arterial Catheter Placement	0.5714	0.5	.8056
I & D	0.6154	0.5714	.9007
Obtain EKG	1.3571	0.7143	.1294
Pelvic Exam	0.9286	0.3571	.2458
Rectal Exam	2.0769	1.6429	.5397

Table 9

Procedural Experience by Gender: GI Surgery Team

Procedure	Mean Experience level-Female (n=11)	Mean Experience level- Male (n=12)	P-value
Place NG Tube	1.4545	1.3333	.8252
Place Foley-Male	3.0909	3.0833	.9728
Place Foley-Female	2.1818	3	.0612
Place IV	2	1.9091	.8857
Venipuncture	2.4545	1.5833	.1890
Dressing change/Wound care	3.3636	3.3333	.9402
Draw ABG	1.6364	1.5833	.9320
Pleural Tap	0.3636	0.1667	.3040
Abdominal Tap	0.1818	0.0833	.5060
Chest Tube Placement	0.5	0.5833	.8271
Chest Tube removal	0.0909	0.3636	.3704
Drain Removal	3.2727	2.5	.1257
Doppler Pulse exam	1.2727	1.3333	.9368
Suture	3	2.9167	.7314
Knot tying	3.2727	3.1667	.6819
Central Venous Catheter Placement	0.8182	0.3636	.0696
Swann-Ganz Catheter Placement	0.3636	0.1667	.3040
Arterial Catheter	0.5455	0.8333	.5007

Placement			
I & D	1	0.9167	.8354
Obtain EKG	1.4545	1	.4430
Pelvic Exam	0.9091	0.0833	.0511
Rectal Exam	2.4545	1.9167	.4374

Gender and self-assessed competence

The only significant finding from the self-reported competence of the entire study group was that women reported greater competence in performing pelvic examinations than men did. (table 10)

Table 10

Self-reported Competence: All Sites

Procedure	Mean self-reported competence-Female	Mean self-reported competence- Male	P-value
Place NG Tube	.7222	1	.4212
Place Foley-Male	2.5	2.1579	.2916
Place Foley-Female	1.5294	1.6842	.7255
Place IV	1.0556	1.4211	.2779
Venipuncture	1.7222	1.8947	.6053
Dressing change/Wound care	2.6111	2.5789	.8818
Draw ABG	1.1111	1.2105	.7997
Pleural Tap	0.0588	0.1053	.7031
Abdominal Tap	0	0.1111	.3313
Chest Tube Placement	0	0.2778	.1720
Chest Tube removal	0	0.2778	.0962
Drain Removal	1.8889	1.5556	.4422
Doppler Pulse exam	1.1765	1.2778	.8406
Suture	1.9444	1.9444	1.0000
Knot tying	2.3889	2.2222	.2910
Central Venous Catheter Placement	0.1176	0.1579	.7364
Swann-Ganz Catheter Placement	0	0.1053	.1628
Arterial Catheter Placement	0.4444	0.2941	.5896
I & D	0.375	0.6111	.4336

Obtain EKG	1.6111	1.4444	.7234
Pelvic Exam	**1.6111**	**0.4211**	**.0024**
Rectal Exam	2.2222	1.7222	.2278

Separating the data by site yields the following results. Consistent with their report of greater experience, male students rotating at the VA report greater competence at performing EKG's and Doppler pulse exams than women do. Among students rotation on the oncology service, men report greater competence with chest tube removal and women report greater competence with knot tying. On the GI team, women report greater competence with drain removal. (Tables 11, 12, 13)

Table 11

Self-reported Competence: VAMC

Procedure	Mean self-reported competence-Female	Mean self-reported competence- Male	P-value
Place NG Tube	.7854	1.444	.1343
Place Foley-Male	2.1429	2.4444	.5157
Place Foley-Female	1.0769	1.4444	.5298
Place IV	1.2857	1.5556	.5695
Venipuncture	2.0714	2.375	.3625
Dressing change/Wound care	2.4286	2.7778	.2252
Draw ABG	1.0769	1.75	.1840
Pleural Tap	0	0	
Abdominal Tap	0	0.125	.3506
Chest Tube Placement	0.1667	0.125	.8578
Chest Tube removal	0	0	
Drain Removal	1.2857	1.25	.9425
Doppler Pulse exam	**2.1538**	**3**	**.0347**
Suture	2.0714	1.875	.4842
Knot tying	2.0714	2.1111	.8297
Central Venous Catheter Placement	0	0	
Swann-Ganz Catheter Placement	0	0	
Arterial Catheter Placement	0.4286	0	.0537

I & D	0.4615	0.8889	,2854
Obtain EKG	**1.5714**	**2.8889**	**.0015**
Pelvic Exam	1	0.6667	.5066
Rectal Exam	2.1429	2.6667	.1156

Table 12

Self-reported Competence: Surgical Oncology Team

Procedure	Mean self-reported competence-Female	Mean self-reported competence- Male	P-value
Place NG Tube	1.1429	1.3571	.6551
Place Foley-Male	2.2143	2	.6156
Place Foley-Female	2.1429	1.7143	.3345
Place IV	1.5	1.3571	.7308
Venipuncture	1.2857	1.6429	.3877
Dressing change/Wound care	2.4286	2.3571	.7885
Draw ABG	1.2143	0.7143	.1908
Pleural Tap	0.0714	0.0714	1.000
Abdominal Tap	0	0.0714	.3356
Chest Tube Placement	0	0	
Chest Tube removal	**0**	**0.8462**	**.0145**
Drain Removal	2.1538	1.6923	.2906
Doppler Pulse exam	1	0.3846	.2257
Suture	1.7143	1.7857	.8068
Knot tying	**2.3571**	**1.7857**	**.0463**
Central Venous Catheter Placement	0.5385	0.2308	.3067
Swann-Ganz Catheter Placement	0.0909	0.0833	.9515
Arterial Catheter Placement	0.2857	0.1538	.5562
I & D	0.1538	0.3571	.3850
Obtain EKG	0.9286	0.6154	.4328
Pelvic Exam	1	0.6923	.4918
Rectal Exam	1.0769	1.2857	.7041

Table 13

Self-reported Competence: GI Surgery Team

Procedure	Mean self-reported competence-Female	Mean self-reported competence- Male	P-value
Place NG Tube	1.0909	1.2727	.6672
Place Foley-Male	2.5455	2.5	.8368
Place Foley-Female	1.8182	2.3333	.1691
Place IV	1.4545	1.75	.3781
Venipuncture	1.5455	1.4167	.7741
Dressing change/Wound care	2.4545	2.5	.8941
Draw ABG	0.9091	1.25	.4639
Pleural Tap	0.1818	0.1667	.9431
Abdominal Tap	0.0909	0.1667	.6949
Chest Tube Placement	0.1	0.4167	.3165
Chest Tube removal	0	0.25	.1911
Drain Removal	2.8182	1.9167	.0176
Doppler Pulse exam	0.8182	1.1667	.5672
Suture	2.0909	2.0833	.9766
Knot tying	2.6364	2.1667	.0511
Central Venous Catheter Placement	0.2727	0.25	.9068
Swann-Ganz Catheter Placement	0.2727	0.0833	.2507
Arterial Catheter Placement	0.2727	0.8182	.1467
I & D	1.3636	1.1818	.7398
Obtain EKG	1.3636	0.5833	.7133
Pelvic Exam	1.9091	1.75	.1295
Rectal Exam	2.1429	2.6667	.7646

Who is teaching procedures to students?

The majority of teaching of procedures is done by mid-level residents, whom students identified as their teachers in 46.1% of their reported procedural instruction events. Interns and chief residents taught 18.3% and 13.6% of procedures, respectively. Students report comparatively little teaching in procedures from attendings (7.7%),

nurses (5.7%), physician assistants (4.8%), and fellow students (2.6%). Students report that 63% of their procedural teaching comes from men and 37% from women. Tables 14 and 15 show the training level and gender, respectively, of the person the student identified as their primary teacher of each procedure listed.

Table 14

Procedural Teaching by Training Level

Procedure	Student	Nurse	PA	Intern	Res	Chief Res	Attg	Other
Place NG Tube	1	0	3	8	33	4	2	0
Place Foley-Male	1	9	0	4	26	21	7	0
Place Foley-Female	0	7	0	0	22	21	5	0
Place IV	1	5	1	3	34	1	1	1
Venipuncture	3	8	2	19	18	0	0	0
Dressing change/Wound care	3	1	7	22	28	6	0	0
Draw ABG	1	1	1	14	27	1	1	1
Pleural Tap	0	1	0	0	3	0	2	0
Abdominal Tap	0	0	0	1	3	1	0	0
Chest Tube Placement	0	0	0	0	9	3	2	0
Chest Tube removal	0	0	0	1	8	3	0	0
Drain Removal	3	0	16	10	25	7	0	0
Doppler Pulse exam	3	1	0	18	8	2	1	0
Suture	0	0	0	4	34	19	8	2
Knot tying	3	0	6	14	22	10	10	0
Central Venous Catheter Placement	0	0	0	1	15	2	6	0
Swann-Ganz Catheter Placement	0	0	1	1	5	1	3	0

Arterial Catheter Placement	0	0	0	1	15	0	2	0
I & D	0	0	0	5	11	6	5	0
Obtain EKG	1	4	1	14	15	0	1	1
Pelvic Exam	0	5	0	2	8	0	0	0
Rectal Exam	1	5	1	8	9	3	7	5
Total	21	47	39	150	378	111	63	10

Table 15

Procedural Teaching by Gender

Place NG Tube	Male	% Male	Female	% Female
Place Foley-Male	38	77.6%	11	22.4%
Place Foley-Female	44	66.7%	22	33.3%
Place IV	30	56.6%	23	43.4%
Venipuncture	33	73.3%	12	26.7%
Dressing change/Wound care	29	63.0%	17	37.0%
Draw ABG	34	56.7%	26	43.3%
Pleural Tap	29	65.9%	15	34.1%
Abdominal Tap	3	42.9%	4	57.1%
Chest Tube Placement	2	50%	2	50%
Chest Tube removal	12	80%	3	20%
Drain Removal	8	72.7%	3	27.3%
Doppler Pulse exam	27	47.4%	30	52.6%
Suture	22	61.1%	14	38.9%
Knot tying	46	69.7%	20	30.3%
Central Venous Catheter Placement	33	53.2%	29	46.8%
Swann-Ganz Catheter Placement	19	76%	6	24%
Arterial Catheter Placement	9	66.7%	3	33.3%
I & D	10	76.9%	3	23.1%

Obtain EKG	15	60%	10	40%
Pelvic Exam	19	55.9%	15	44.1%
Rectal Exam	6	40%	9	60%
Place NG Tube	25	65.8%	13	34.2%
Total	493	63.0%	290	37.0%

Discussion

This survey indicates that the core surgical rotation at Yale University School of Medicine is no exception to the general trend of insufficient procedural skills exposure in medical education. Students do generally achieve the goal of performing certain procedures independently or with help while on the surgery rotation: the average student rating for dressing change/wound care, knot tying, placing male and female foley catheters, suturing, and venipuncture fell at "performed with assistance" or greater. However, the curriculum goals of having students perform IV catheter placement, Doppler pulse exams, and nasogastric tube placement are generally not met. Additionally, the majority of students report never seeing or being taught about arterial catheter placement, Swann-Ganz catheter placement, or pleural tap, which are procedures they are expected to observe or participate in, according to the curriculum. It is also interesting to note that several students report very minimal or no exposure to procedures considered basic to during surgery rotation: 7 students (8.8% of respondents) reported never tying a knot, 5 (6.3% of respondents) reported never suturing, and 29 (36.3% of respondents) never performed venipuncture.

It is possible that students are being exposed to these procedures on other rotations, such as anesthesiology, OB/GYN, or surgical subspecialty rotations. However, if the surgery department does indeed expect students to encounter the procedures outlined in the guidelines, there is clearly room for improvement. Since it has been

shown that providing students with a checklist of procedures to perform/observe increases their exposure to procedures, perhaps distributing a procedures list in a "checklist" format would help guide students during the rotation. Such a checklist would also provide the student with something to show to his or her supervisors so that they may also become more alert to opportunities for teaching procedures. Improvement in this area may help prepare students regardless of specialty career choice.

In terms of gender discrepancies, it seems that, in general, there is equality between male and female medical students in performance of procedures when all sites are considered. It is possible that the finding that male students performed more female Foley catheter insertions and chest tube removals are statistically random. However, when the sites for surgery rotation are considered independently, it is interesting to note that while men and women report similar experiences with procedures on the GI Surgery team and the Surgical Oncology team, it appears that men and women who rotate at the VA may have different experiences. At this site men reported significantly greater experience with chest tube placement, chest tube removal, Doppler pulse exam, and obtaining EKG's with a corresponding greater self-reported competence in Doppler pulse exam and obtaining EKG's. It is interesting to note that student experience varied the most in a hospital where the vast majority of patients are male, raising the question of how patient gender may influence procedural skill exposure.

Overall, however, this data contradicts the anecdotal idea that men enjoy greater exposure to procedures than women do. This is one small indication of improvement in an area where women generally perceive that gender inequality exists. The presence of women mentors is clearly an important factor in encouraging women to pursue a career in

surgery, increasing exposure to women mentors may be the most effective step a program could take in countering women's' reluctance to go into surgery.

The final aim of this project was to assess who is teaching procedures to medical students. Analyzing the data by training level of the teacher shows that students identified the surgical housestaff as their primary teachers in procedural skills: 78% of all procedural teaching was done by housestaff. Surgical attendings did comparatively little instruction in procedural skills (7.7% of all teaching). However, students learned some basic skills more frequently from attendings, such as knot tying (16.9% of students taught by an attending) and suturing (11.9% taught by an attending). This suggests that surgical faculty do make an effort to instruct students in basic skills, and that these are the procedures most easily taught during the time spent together, most likely in the operating room. Finally, students reported relatively little teaching from nurses, physician assistants, and other students. The skill sets of ancillary medical staff as well as the knowledge of more experienced students may be useful resources to draw on in order to increase student exposure to procedures.

Evaluating the data in terms of gender yields some interesting results. Women currently comprise 25.4% of surgical residents nationwide and 30.4% of surgical residents at Yale University. However, the Yale Surgery Department reports that during the summer 2004-summer 2005 year in which most of the surveyed students rotated, the surgical housestaff they would have been exposed to (all categorical residents plus preliminary interns) was only 15.6% female. When students identified a surgical housestaff member as their teacher that person was female 26.4% of the time (64.2% male, 9.4% no gender identified). The failure to identify gender in 9.4% of the teaching

incidents described makes interpretation of this data difficult; however, it appears that female housestaff at Yale University teach procedures at a ratio that is greater than their representation in the residency as a whole.

A similar result is found when analyzing faculty teaching by gender. Women comprise 15% of surgical faculty nationwide, 17% of surgical faculty at Yale University School of Medicine, and 38.5% of the faculty on the services the surveyed students rotated through. However, when students identified a faculty member as the teacher of a procedure, 47.6% of the time that faculty member was female (49.2% male, 3.2% no gender reported). This suggests that the female faculty of the Yale University Department of Surgery are doing relatively more teaching of procedures to medical students than their male colleagues. Their disproportionate representation on the services that serve to educate junior medical students also speaks to the commitment of the female faculty at Yale University to medical student education.

This assessment suggests several interesting findings about the state of education in surgical procedural skills at Yale University. Students at Yale University are, like students at other studied medical schools, likely to receive inadequate training in procedural skills. Although an anecdotal perception of gender inequality in terms of procedural exposure exists, in general male and female medical students receive equal exposure to procedural skills (with the possible exception of student rotating at the VAMC, where men had significantly more exposure to 4 out of 22 procedural skills). The vast majority of students' education in procedures comes from housestaff, with female housestaff being identified as teachers in greater proportion than their representation in the residency. Surgical attendings do a relatively small percentage of

procedural teaching, but female attendings appear to do more teaching in procedures than their male colleagues do. Suggestions for further improvement of education in surgical procedures at Yale University include distribution of a checklist of the procedural skills students are expected to master or observe during surgery rotation, awareness of possible gender inequality in terms of procedural exposure at certain rotation sites, and utilization of the expertise of nurses, physician assistants, and more experienced students to create more educational opportunities. Continued encouragement of procedural teaching by surgical housestaff and attendings is also important, including commending the female residents and faculty for their level of teaching and encouraging their male colleagues to follow suit.

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